WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a semiconductor substrate;

an active element structure formed on the semiconductor substrate;

a first insulating film provided above the semiconductor substrate;

a first interconnect layer provided in a surface of the first insulating film and composed of copper;

a second insulating film provided on the first insulating film;

a connection hole formed in the second insulating film and having a bottom connected to the first interconnect layer;

a connection plug composed of a single crystal of copper filling the connection hole so that no other crystals of copper are provided in the connection hole;

an interconnect trench formed in a surface of the second insulating film and having a bottom connected to the connection hole; and

a second interconnect layer provided in the interconnect trench.

2. The device according to claim 1, further comprising a diffusion preventing metal film extending from a bottom of the connection hole to a side wall of the connection hole and an inner surface of the interconnect trench and composed of a material selected

from a group consisting of Ti, W, Ta, Nb, Al, V, Zr, Ni, and their nitrides and oxides, the diffusion preventing film having a thickness of 0.1 to 1 nm.

3. The device according to claim 1, further comprising a diffusion preventing metal film provided on a inner surface of the connection hole and having an opening reaching the first interconnect layer at the bottom of the connection hole, the diffusion preventing metal film being composed of a material different from copper.

4. The device according to claim 3, wherein the diffusion preventing metal film is composed of a material selected from a group consisting of Ti, W, Ta, Nb, Al, V, Zr, Ni, and their nitrides and oxides.

5. The device according to claim 1, wherein the copper of the connection plug has the same crystal orientation as that in a part of the first interconnect layer which is located immediately below and close to the connection hole in the first interconnect layer.

6. The device according to claim 3, wherein the copper of the connection plug has the same crystal orientation as that in a part of the first interconnect layer which is located immediately below and close to the connection hole in the first interconnect layer.

7. A method of manufacturing a semiconductor device comprising:

forming an active element structure on the

semiconductor substrate;

forming a first insulating film above the semiconductor substrate;

forming an interconnect layer composed of copper in a surface of the first insulating film;

forming a second insulating film on the first insulating film;

forming a connection hole and an interconnect trench in the second insulating film, the connection hole having a bottom connected to the interconnect layer, the interconnect trench having a bottom connected to the connection hole;

filling the connection hole with copper formed on the interconnect layer by epitaxial growth so as not to form any other crystals of copper in the connection hole; and

filling the interconnect trench with copper.

8. The method according to claim 7, further comprising:

after forming the connection hole and before filling the connection hole,

forming a diffusion preventing metal film covering inner surfaces of the connection hole and interconnect trench and composed of a material selected from a group consisting of Ti, W, Ta, Nb, Al, V, Zr, Ni, and their nitrides and oxides, the diffusion preventing film having a thickness of 0.1 to 1 nm; and

forming a base film composed of copper, on the diffusion preventing metal film.

9. The method according to claim 8, wherein filling the connection hole includes forming the copper by an electroplating method using the base film as a base.

10. The method according to claim 7, wherein filling the connection hole includes:

forming a base film composed of copper, on the interconnect layer at the bottom of the connection hole; and

forming the copper by an electroplating method using the base film as a base.

11. The method according to claim 7, wherein filling the connection hole includes forming the copper by an electroless plating method using the interconnect layer as a base.

12. The method according to claim 7, further comprising:

after forming the connection hole and before filling the connection hole,

forming a diffusion preventing metal film covering inner surfaces of the connection hole and interconnect trench and composed of a material different from copper; and

removing the diffusion preventing metal film from the bottom of the connection hole.

13. The method according to claim 7, wherein filling the connection hole includes:

forming a diffusion preventing metal film at the bottom of the connection hole, the diffusion preventing metal film being composed of a material different from copper;

forming a base film composed of copper, on the diffusion preventing metal film; and

forming the copper by an electroless plating method using the base film as a base.